December 19, 1991

Office of the Secretary
Federal Communications Commission
Washington, DC 20554

In the Matter of
Advanced Television Systems
and Their Impact Upon the
Existing Television Broadcast
Service

MM Docket No. 87-268

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DEC 2 0 1991

Federal Communications Commission
Office of the Secretary

COMMENTS OF
Vinod Khosla
General Partner
Kleiner Perkins Caufield & Byers

Palo Alto Office
Two Embarcadero Place
2200 Geng Road
Palo Alto, CA 94303
Telephone (415) 424-1660
FAX (415) 856-2760

General Partners
Vinod Khosla
E. Floyd Kvamme
James P. Lally
Regis McKenna

Venture Partners
Joseph S. Lacob
Bernard J. Lacroute
Robert R. Maxfield

Consultant
Eugene Kleiner

San Francisco Office
Four Embarcadero Center
Suite 3520
San Francisco, CA 94111
Telephone (415) 421-3110
FAX (415) 421-3128

General Partners
Brook H. Byers
Frank J. Caufield
L. John Doerr
Thomas J. Perkins

First a word on my background. I am a general partner with one of the leading venture capital firms in the nation, Kleiner Perkins Caufield and Byers. The firm was responsible for the the birth of companies like Genentech in biotechnology, Compaq and Lotus in personal computers, Sun Microsystems in workstations, Picturetel in video teleconferencing and many others. I have personally been responsible for the start of two major technology companies (Sun Microsystems and Daisy Systems), and have made very early investment in videoconferencing (Picturetel), multimedia, interactive entertainment (in a joint venture with Time Warner and Electronic Arts).

In picking a digital standard for HDTV for the year 1995 through at least 2050 it is inconceivable that (1) it would not allow for scalability in every possible way, and that (2) it would not be oriented towards computational technologies and computer standards.

Today we are seeing digital display resolutions in the one million pixel range. Given that many of the technologies are based on semiconductor like processing (Active matrix, TFT, Light valve), technologies that in the last ten years have seen

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10X improvements in density and are expected to see factors of 100X in the next ten years, it is highly likely that we will see display technologies with resolutions of 10 million pixels or more in the next ten years. It is hard to conceive what the year 2050 will bring when nanotechnology based manufacturing (putting systems together one molecule at a time) will be routine! Further fixed resolutions will significantly slow down the adoption curve of digital television. Even one million pixel resolution television screens will be too expensive for the year 1993-94. The technology must allow affordability (half million pixel screens) in 1993 and performance in 2050 (todays laser printer 300 dots per inch quality on a 20 ft X 20 ft screen or 60000 X 60000 resolution - or 4 giga pixels! This is minimum reasonable resolution for the information based services of the future like digitally transmitted newspapers). The only way to do this is to have the technology be resolution independent (like Postcript display standards are today in the Computer world) or be self describing across a wide range of resolutions and usable in full resolution or fractions thereoff. This will allow even the broadcast signal to change over time.

Similarly we are in the infancy of compression technologies. It would be like picking a 640K memory size personal computer as a standard for the year 2020 just because it seemed reasonable in 1980. It ran out of gas well before 1990! We are in the infancy of research in that area with significant efforts in DCT technologies (MPEG and Px64- a standard that is unlikely to survive into the year 2000), Wavelet technologies, Fractal based technologies, Neural net based compression technologies and many others. Any standard we pick today would be obsolete in the year 1995 let alone 2050. The solution is to pick something that can be described by the broadcast signal. The decompression software should be downloaded over the air into signal processors capable of at least running a family of algorithms. The attempt here is to describe the problem not the solution because minds better than mine are available to propose alternative and better solutions to the problem.

On the subject of computational technologies, much of the television entertainment and education in the year 2000 and beyond will be "computed or processed". Interactive television will probably be the significant means of education and entertainment. Today Nintendo has already shown how

pervasive even crude interactive technologies can be. The next generation of interactive computers are going to encompass far more than the shoot-em-up style that mostly appeals to 5-15 year old boys. These systems will encompass education, entertainment and infotainment as well as services (like home shopping) that apply to 2-100 year olds, male or female. To not have affinity to computational and multimedia technologies (like square, non-interlaced) would result in a significant slowdown in realizing the full potential of these systems.

Sincerely,

Vinod Khosla

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